of these patents *class* the several *operations* requisite in working wood to any form required, straight or bevelled, and describe machines by which these several operations may be performed; amongst them perhaps all that are necessary for the production of a finished block. Circumstances irrelevant to the present subject induced him to have various of his machines made, and put to actual work at his brother's residence, among which were some of the *identical* machines afterwards forming part of the general system of block machinery at Portsmouth. The then First Lord, and other Lords of the Admiralty, visited these engines when in operation in the year 1795, and, convinced of the advantages that would result from their introduction into naval arsenals, induced Sir Samuel to re-engage in the naval service as Inspector-General of Naval Works. Amongst other articles then intended to be manufactured on Government account were blocks. By degrees many of these machines were removed from his residence to Portsmouth and Plymouth dockyards, such as his apparatus for boring, mortising, cutting of grooves and tenons, as also reciprocating saws, with his new apparatus for giving them motion in different directions, and circular saws with his improvements, including machinery that enabled them to cut at pleasure to any desired depth, or at any desired angle. The Lords of the Admiralty, during their visitation of the dockyards in 1802, inspected some of these machines when at work, as is recorded in their "Minutes of Proceedings," page 45.

It was in the same year, 1802, that Sir Isambard (then Mr.) Brunel presented himself, unknown and unrecommended, with drawings of his block machinery, to General Bentham. The drawings exhibited "at that time embraced only some of the operations requisite in forming the *shells* of blocks," but "they exhibited great ingenuity and mechanical skill." The inspector-general's time happened to be fully occupied, at the first lord's desire, in matters of general management, so that, after much inquiry respecting Mr. Brunel, Sir Samuel mentioned to Lord St. Vincent Mr. Brunel's invention, and advised that gentleman to propose his machine to the Admiralty: on receipt of the proposal the Admiralty board referred it to the inspector-general "to consider and report what in your opinion may be proper to be done thereupon."

The general, in his report, 15th April, 1802, said "he was convinced that the invention is well suited to the purpose of manufacturing blocks with a degree of accuracy, uniformity, and cheapness beyond what can be expected from the *modes hitherto in use*." Mr. Brunel's machine was in consequence adopted, and he was directed by their lordships to concert with the machinist in the inspector-general's office as to the best mode of fixing up the different engines and apparatus, so that it "should combine with the apparatus *already provided*, or which it may seem advisable to erect, in that dockyard." General Bentham was charged with the examination and approval of the several drawings of proposed machines, and with the responsibility, as well, of checking all payments for them.

From this time the inspector-general and the machinist united with Mr. Brunel in endeavours to render the whole apparatus for making blocks as perfect as possible. Several of Sir Samuel's machines already in the dockyard were employed as part of the block machinery; and, with a view to engage public opinion in favour of machinery, he gave a preference to that for block-making, as it was susceptible of a pleasing arrangement.

But it is time to particularize the several block machines, so that each inventor may receive due acknowledgment of his skill: this may best be done by reference to the several operations requisite for the formation of a finished block, and by making use of the descriptions and drawings of the Portsmouth block machinery as given in Ure's Dictionary: but in which, however, the invention of the whole of it is ascribed to Mr. Brunel. It seems almost a needless repetition to say that the simple circular saw was invented by the Messrs. Taylor.

The several operations in forming a block shell are—

1. To cut out the shell to size from the rough log.—Described article 1. of Ure—"The straight cross-cutting saw, and the circular cross-cutting saw." These saws were amongst the machinery from General Bentham's that were inspected by the Lords of the Admiralty in 1802: the first articles of Mr. Brunel's machinery did not arrive at the yard till 15th April, 1803. These reciprocating saws were fitted up with General Bentham's machinery for insuring precision in the work done by them, and the circular saws were with his contrivances for enabling them to cut at pleasure to any angle, or to any depth.

2. To bore for mortising and pin-hole.—Messrs. Taylor used boring machinery. That employed at Portsmouth appears to have been General Bentham's improved borers, by which the tool was directed as might be required, whilst the wood was held firmly in its place at the required angle or height. Mr. Brunel probably made some alterations of this engine to suit it particularly to the boring of block shells. The machine at Portsmouth differs from Mr. Taylor's in the important particular, that, at Portsmouth, the block is confined precisely in the required direction to receive the borers, besides that holes are bored in different directions at one and the same time.

3. To mortise.—This, too, is an adaptation of General Bentham's machine to the particular purpose of mortising a block shell.

4. To cut off corners.—Fig. 132, Ure's Dictionary. It is the improved circular saw of General Bentham. The improvement in this instance consisted in his invention of an apparatus by means of which the saw cut accurately, at pleasure, to any desired angle, or to any required depth. It is represented, however, by Ure, as fitted only to cut at one particular angle.

5. To shape.—This operation was performed by hand in Messrs. Taylor's factory. Mr. Brunel invented the shaping machine: it is amongst the most important of his contrivances, on account of the accuracy and uniformity given by it to block shells, over and above great savings of expense.

6. To score.—Fig. 133 of Ure. Done by hand at Messrs. Taylor's factory. The engine for performing this difficult operation was of Mr. Brunel's invention; it insures perfect accuracy in this important part of the shell.

SHIEVES.

1. To cut off slices of lignum vitæ to the required thickness.—A combination of the saws above mentioned arranged for this purpose by Mr. Brunel.

2. To bore and round.—Performed at Portsmouth by means of an ingenious machine of Mr. Brunel's invention. Fig. 134 of Ure exhibits the *crown* saw, and the other apparatus as contrived by Mr. Brunel.

3. To prepare for coque.—Done by hand at Messrs. Taylor's; at Portsmouth by a machine of Mr. Brunel's invention. By this engine three semicircular indents are excavated round the hole at the centre of the shieve; by the accuracy thus given to the bed for the coque it exactly fills up the indent, so as to prevent its former looseness in the shieve.

4. To drill for rivets.—Brunel.

5. To rivet.—This little tilt hammer affords an instance of the combination of endeavours to perfect the whole apparatus. Riveting was at first done by hand at Portsmouth, but when the inspector-general was one day examining the works, it was observed that the strokes of the hammer as given by the boy were irregular, and a tilt hammer was suggested in lieu of the hand. Mr. Brunel immediately adopted the idea, and introduced the tilt hammer with a suitable band for working it.

6. To broach according to size of pin.—Brunel.

7. To turn and polish.—The ordinary lathes of block-makers.

PINS.

They were for some years obtained from Sheffield at less cost than they could be manufactured for in the dockyard. Subsequently the inspector-general caused a blacksmith's shop to be fitted up for convicts' use in the floating-dam of the basin, from which time the pins were forged by convicts, and afterwards turned and polished by machines of Mr. Brunel's.

FINISHING THE BLOCK.

Putting the shieve and the pin into the block shell.—By hand: this being the only operation for which suitable machinery is not provided at Portsmouth.

Mr. Brunel, by attention to the parts that had failed, of condemned blocks, perceived where additional strength was required, and provided for giving it; thus the ends of the shells, where they had so frequently split, he made thicker than theretofore; the iron pins he coated with tin, to prevent rust; the coques were of a mixed metal, greatly improved in quality after much investigation by the inspector-general, Mr. Brunel, and Mr. Maudsley. These and many other improvements tended to the greater durability of blocks. Indeed, after the time when the Portsmouth-made ones had come into general use, it was found that the consumption of them had greatly diminished in proportion to the number of vessels in commission. This was, in part, consequent on the improvement of the blocks themselves, but still more, it was confidently affirmed, on the uniformity and accuracy with which the blocks were made by the Portsmouth machinery,—inimitable but by other such machinery—so that the form and finish of these blocks proved far better security against embezzlement than the king's mark had ever been.

The machinery necessary for giving motion to Mr. Brunel's apparatus was devised in the inspector-general's office, Mr. Brunel "having had a considerable share in its contrivance."

As to pumps, and many other articles included in the block-makers' contract, they were manufactured from the year 1805 in Portsmouth-yard by means of the sawmills, lathes, and other engines erected there according to the inspector-general's plans.

"N. R." attributes the discontinuance of Mr. Taylor's contract to the cessation of his patent. It expired, however, in the year 1799, consequently ten or eleven years before there was question of Mr. Brunel. In point of fact, Mr. Taylor's contract continued till the year 1805.

"N. R." further states, that Mr. Taylor's claim to the invention of the Portsmouth machinery was insisted on during Sir Isambard Brunel's lifetime, and never denied. In looking over all the official correspondence on the subject, and numerous private papers, it does appear that Mr. Taylor had represented that "no saving could result" from the Portsmouth block machinery; a saving, however, did result from it, of above 16,000*l.* a-year: "that it never would be found competent to the supply of the navy;" but during the heat of the war it did not only supply the navy, but also all the demands of the Ordnance department: that the hopes of the sufficiency of that machinery were "the sanguine but groundless expectations of a visionary projector;" yet amongst these and similar representations no hint even is to be found that either Mr. Walter Taylor or his father had been the *inventors* of the Portsmouth block machinery. Mr. Taylor was well known to be adverse to it; yet from the year 1803, when it was officially announced that Mr. Brunel's remuneration was to be a-year's savings made by his machinery, to the year 1810, when the amount of these savings was calculated and awarded, not on any one occasion can it be found that Mr. Taylor ever urged, as against that remuneration, either his own or his father's previous invention of that machinery,—though, had it been so, such a claim would have been examined into, and if found just, would have afforded legitimate reason for giving remuneration to Mr. Taylor, and for either withholding it altogether from Mr. Brunel, or for according to him only such an amount of money as might have been equivalent to savings produced by his improvements of Mr. Taylor's machinery.

For particulars as to Mr. Brunel's remuneration see *Mechanics' Magazine*, No. 1376, page 592, in which it appears that Sir Samuel Bentham, in speaking of his own machinery used in the block-making apparatus at Portsmouth, had expressed himself "satisfied that Mr. Brunel had skill enough to have contrived machinery to have answered the same purposes, had he not found mine ready to his hands."

PORTRAIT OF THE LATE MR. ELMES.—Agnew, of Manchester, has just now published a portrait of the late H. Lonsdale Elmes, architect of the new Assize Courts, Liverpool. It is nicely engraved in the mixed style, by Mr. T. O. Barlow, from a painting in the possession of Mr. Rawlinson.

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